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(54) **Split slipring for maintainability**

Gespaltener Schleifring zur Wartbarkeit

Bague collectrice fendue pour la facilité de maintenance

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Description

BACKGROUND

[0001] This invention relates generally to an assembly used to provide electrical power and communication signals operating on a rotating portion of an aircraft. More particularly, the present invention relates to a slip ring used with an aircraft rotating component such as a propeller, and specifically attached to the aft portion of the propeller hub.

[0002] Present propeller designs are connected to the gearbox output shaft using a bolted flange on the propeller hub. The flange connection adds weight to the aircraft. An alternative to a bolted flange is hub that is integral with the gearbox output shaft. The slip ring assembly conventionally employed provides electrical connections between the rotating and non-rotating components of the propeller. Conventional slip rings have non-rotating brushes conductively coupled to one side of each connection and slidingly engaging rotating rings that arc conductively coupled to the other side of each connection. In time, the brushes become worn and need to be replaced. Removal of the slip ring, for maintenance or replacement, requires complete removal of the propeller, or in the case of an integral hub and gearbox shaft replacement requires complete removal of the gearbox.

[0003] Not providing maintenance and service for slip ring assemblies is not an option since failure of the slip ring, such as by brush failure, may result in the inability of the deicing equipment to properly function. Slip rings as described in the preamble to claim 1 are known from US 2453073 and US 4294500.

SUMMARY

[0004] A slip ring is formed from two parts that form a smooth surface for the brushes to ride on. The two halves are assembled apart from the propeller hub and are machined to give a uniform surface with a tolerance between the diameters of the two parts being less than 0.1 micron. Thus the smooth surface at the junction when the two components are assembled together has essentially no step that would adversely affect the wear on the stationary brushes.

[0005] The two parts are held together by a fastener such as a pair of bolt and nut assemblies at the junction of the two parts. A guide such as a dowel may be used to effectively align the two components to maintain the smooth junction. The slip ring can then be easily attached to a propeller hub or other rotating element. The electrical connections to the slip ring and the stationary brushes are made to transmit the electrical power for deicing the propeller, or another appropriate signal that slip rings are designed to transmit. Due to the split design a jumper wire or other electrical connection is required between the first half of the slip ring and the second half.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 is a section view of the nose of an aircraft propeller assembly showing the location of the present invention.

[0007] FIG. 2 is an enlarged view of the components shown in circle 17 in FIG. 1.

[0008] FIG. 3 is a rear elevational view of the assembly of this invention.

[0009] FIG. 4 is an alternative view of a portion of the assembly in FIG. 3.

[0010] FIG. 5 is a view of a part of the assembly in FIG. 4.

DETAILED DESCRIPTION

[0011] The present invention is useful for most aircraft propellers, particularly those that have a deicing feature. Slip rings are used to transfer a signal or electric current to or from a stationary component to a rotating component, where the ring rotates and the brushes remain fixed or stationary. The use of a slip ring that could be disassembled separately would permit assembly or replacement of the ring in the field and would eliminate the need for the conventional flange now being used to connect the propeller and gearbox shaft allowing the hub to be integrated with the gearbox shaft.

[0012] A typical aircraft propeller assembly 10 is shown in Fig. 1, with parts cut away. Blade 11, also cut away, is driven by a shaft 13 that drives blade 11 in a conventional manner. Shaft 13 takes the rotation of the gas turbine engine, which may operate at 20,000 rpm, and has been reduced by a gearbox to a useable rotation for the blades to 1,200 rpm or the like. Fig. 1 shows where the slip ring assembly 17 is located. Slip ring assembly 17 is attached to the hub using a suitable connection like bolts. Spinner 15 is an aerodynamic shell that houses blade counterweight 21. Blade counterweight 21 serves as a safety device when the system hydraulics, not shown, fail, and aligns blade 11 in a position of least drag, rather than allowing blade 11 to turn to the greatest drag. Other conventional elements in the spinner 15 are blade retention assembly 23, spinner support bulkhead 25, hub 27 and actuator 29. Actuator 29 controls the pitch angle of blade 11.

[0013] The slip ring transmits electrical power for blade deicing, and can be used for other purposes such as transmitting control signals. Fig. 2 illustrates the slip ring assembly 17 in greater detail. Three slip rings 31a, 31b and 31c are mounted in a non-conductive slip ring housing 33. Housing 33 is attached to support 19 with a structural slip ring housing 35. Housing 35 is made of aluminum in this assembly though any conductive structural material is suitable. Heater leads 37 are connected to the slip ring housing with threaded studs 39 which are electrically and structurally attached to the back of the slip rings, and retention nuts 41, and the heater leads 37 transmit the electrical current to the de-icer unit, not

shown, in a conventional manner. The brushes 43A for slip rings 31a, 31 b and 31c are mounted in a housing 43 and attached to the gearbox front housing 47 by bracket 45. Brushes 43A are shown spaced a bit from slip rings 31a, 31b and 31c to illustrate their separate shapes, but in operation, rings and brushes are in contact to function in a normal manner. Housing 35 is rotated by support 19 as the entire propeller assembly 10 rotates. Slip rings 31a, 31b and 31c transmit or receive electrical signals to or from stationary brushes 43A. For example, brushes 43A may transmit electrical energy to slip rings 31a, 31b and 31c to power a de-icer unit.

[0014] Fig. 3 is a rear view of the slip ring assembly with slip rings 31a, 31b and 31c joined together at junction 49 inside conductive housing 35 and non-conductive housing 33. Split line bolts 51 and nuts 53 hold a matched set of bulkheads 55 and 57 to support slip rings 31a, 31b and 31c in place in housings 33 and 35. Bulkheads 55 and 57 are aligned with one or more alignment dowels 59. Alignment keys could be used. Not shown in Fig. 3 are jumper wires between each slip ring half to maintain electrical continuity. Prior to assembly and use in an aircraft, the split rings 31a, 31b and 31c are assembled and the inner surfaces are machined to virtually zero tolerance, less than 0.1 micron, at junction 49 so that the junctions 331a, 331b and 331c have no step or misalignment and present a smooth running surface to the brushes 43a. When reassembled, split rings 31a, 31b and 31c present that smooth running surface to the brushes 43a and function as if the split ring junctions shown as 331a, 331b and 331c were formed from a solid ring rather than from two halves, with smooth running surfaces so the life of the brushes is not affected. Accordingly, when the slip ring assembly 17 is installed in an aircraft or other location where slip rings are used, slip rings 31a, 31 b and 31 c of Fig. 2 function as any slip ring does. When the rings have become worn or damaged, however, it is a simple matter to remove nuts 53 from bolts 51 without having to disassemble anything else, and they can be repaired or replaced at a substantial saving in time and labor. As seen in Figs 1-3, rings 31a, 31b, 31c are planar and all lie in the same plane.

[0015] Fig. 4 illustrates a different orientation for split slip rings 131a, 131b and 131c which are mounted on non-conductive housing 133, which is in turn mounted by bolts 139 and nuts 141 on hub 135. Split slip rings 131a, 131b and 131c operate in a conventional manner with brushes 143A, which are mounted in housing 143 and attached to gearbox 147 with bracket 145. Again split slip rings 131 a, 131 b and 131 c are first assembled outside the location of use, and junction 149 is machined to have a smooth running surface. Then split slip rings 131a, 131b and 131c are put into location and they function as other slip rings do and are in contact with brushes 143A, rather than spaced as shown for illustration purposes.

[0016] Fig. 5 shows how the junction 149 mates the two halves of split slip rings 131a, 131b and 131c. They

are held in place with bolts and nuts 141. Junction 149 has been machined to join the two halves of split slip rings 131a, 131b and 131c to function as conventional solid rings. Jumper wires are required between each slip ring half. In the embodiment of Figs 4 and 5 the rings 131 a, 131b, 131 c are cylindrical.

[0017] Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the scope of the invention, which is defined by the claims and their equivalents.

15 Claims

1. A slip ring assembly (17) for an aircraft propeller assembly (10), comprising:

first and second halves of a slip ring (31a,31b, 31e;131a,131b,131c) having a contact surface for rotational engagement with a stationary brush element (43A; 143A) for transferring electrical signals therebetween, the contact surface having a junction (49;149) of the first and second halves;

a fastener (51,53;141) locating the first and second halves to form a ring shape; and
an electrical contact (39,41) on the ring for carrying electrical signals;

characterised in that:

the first and second halves form a smooth junction with a tolerance of less than 0.1 micron when assembled on a rotatable shaft (13).

2. The assembly of claim 1, wherein the fastener includes an alignment element (59) for aligning the first and second halves to form the smooth surface at their junction.

3. The assembly of claim 2, wherein the alignment element (59) for aligning the first and second halves to form the smooth surface at their junction is selected from alignment dowels and alignment keys.

4. The assembly of claim 1, 2 or 3 which further includes a stationary brush element (43A; 143A) in contact with the rotating surface for transferring electrical signals therebetween, the assembly being mounted in operable relationship with an aircraft propeller assembly (10).

5. The assembly of claim 1, 2, 3 or 4 wherein the fastener includes at least two pairs of split line bolts and nuts (51,53;141).

6. The assembly of any preceding claim, wherein the slip ring assembly includes a stationary brush element (43A; 143A) in contact with the rotating surface and the slip ring assembly is mounted on a propeller hub (27) and gearbox (47) assembly having a drive shaft (13) for driving the hub. 5
7. The assembly of claim 6, wherein the slip ring assembly is used with a heater lead (37) on a propeller on the propeller hub (27). 10
8. The assembly of claim 6 or 7, wherein the slip ring assembly is mounted on an aft flange on the propeller hub that connects the propeller hub to the drive shaft (13) of the gearbox. 15
9. The assembly of claim 6, 7 or 8 wherein removal of the fastener in the slip ring assembly and separating the first and second halves of the slip ring exposes the slip rings for replacement or repair. 20
10. The assembly of any preceding claim wherein the or each slip ring is planar. 25
11. The assembly of any preceding claim wherein the or each slip ring is cylindrical.. 25
12. A method of making a slip ring assembly comprising forming first and second halves of a slip ring (31a, 31b,31c;131a,131b,131c) therebetween; assembling the first and second halves together and machining them to produce a junction; assembling the two halves on a rotatable shaft (13); and joining the first and second halves with a fastener (51,53;151) to form a ring shape; 30
characterised in that the first and second halves are machined to produce a smooth junction with a tolerance of less than 0.1 micron. 35

Patentansprüche

1. Schleifringanordnung (17) für eine Luftfahrzeugpropeller-Anordnung (10), umfassend: 45
 eine erste und eine zweite Hälfte eines Schleifrings (31 a, 31 b, 31 c, 131 a, 131 b, 131 c), die eine Kontaktfläche zum Rotationseingriff mit einem stationären Bürstenelement (43A, 143A) aufweisen, um zwischen diesen elektrische Signale zu übertragen, wobei die Kontaktfläche eine Verbindungsstelle (49, 149) der ersten und zweiten Hälfte aufweist, 50
 ein Befestigungsmittel (51, 53, 141), das die erste und die zweite Hälfte derart anordnet, dass sie eine Ringform bilden, und 55
 einen elektrischen Kontakt (39, 41) an dem Ring zum Leiten elektrischer Signale,

dadurch gekennzeichnet, dass:

- die erste und die zweite Hälfte eine glatte Verbindungsstelle mit einer Toleranz von weniger als 0,1 Mikrometer bilden, wenn sie auf einer Drehwelle (13) angeordnet sind.
2. Anordnung nach Anspruch 1, wobei das Befestigungsmittel ein Ausrichtungselement (59) zum Ausrichten der ersten und der zweiten Hälfte zwecks Bildung der glatten Fläche an deren Verbindungsstelle beinhaltet. 10
3. Anordnung nach Anspruch 2, wobei das Ausrichtungselement (59) zum Ausrichten der ersten und der zweiten Hälfte zwecks Bildung der glatten Fläche an deren Verbindungsstelle aus Ausrichtungsdübeln und Ausrichtungskeilen ausgewählt ist. 15
4. Anordnung nach Anspruch 1, 2 oder 3, die ferner ein stationäres Bürstenelement (43A, 143A) in Kontakt mit der Rotationsfläche beinhaltet, um zwischen diesen elektrische Signale zu übertragen, wobei die Anordnung in funktionsfähigem Verhältnis zur einer Luftfahrzeugpropeller-Anordnung (10) montiert ist. 20
5. Anordnung nach Anspruch 1, 2, 3 oder 4, wobei das Befestigungsmittel mindestens zwei Paare aus Splintbolzen und Muttern (51, 53, 141) beinhaltet. 25
6. Anordnung nach einem der vorhergehenden Ansprüche, wobei die Schleifringanordnung ein stationäres Bürstenelement (43A, 143A) in Kontakt mit der Rotationsfläche beinhaltet und die Schleifringanordnung auf eine Anordnung aus Propellernabe (27) und Getriebe (47) montiert ist, die eine Antriebswelle (13) zum Antreiben der Nabe aufweist. 30
7. Anordnung nach Anspruch 6, wobei die Schleifringanordnung mit einem Heizkabel (37) an einem Propeller an der Propellernabe (27) verwendet wird. 35
8. Anordnung nach Anspruch 6 oder 7, wobei die Schleifringanordnung an einen hinteren Flansch an der Propellernabe montiert ist, der die Propellernabe mit der Antriebswelle (13) des Getriebes verbindet. 40
9. Anordnung nach Anspruch 6, 7 oder 8, wobei das Entfernen des Befestigungsmittels in der Schleifringanordnung und das Trennen der ersten und der zweiten Hälfte des Schleifrings die Schleifringe zum Austausch oder zur Reparatur freilegen. 45
10. Anordnung nach einem der vorhergehenden Ansprüche, wobei der oder jeder Schleifring planar ist. 50
11. Anordnung nach einem der vorhergehenden Ansprüche, wobei der oder jeder Schleifring zylindrisch 55

ist.

12. Verfahren zur Herstellung einer Schleifringanordnung, umfassend das Bilden einer ersten und einer zweiten Hälfte eines Schleifrings (31 a, 31 b, 31 c, 131a, 131b, 131c) dazwischen, das Zusammensetzen der ersten und der zweiten Hälfte und deren Bearbeitung, um eine Verbindungsstelle zu erzeugen, das Anordnen der zwei Hälften auf einer Drehwelle (13) und das Verbinden der ersten und der zweiten Hälfte mit einem Befestigungsmittel (51, 53, 151), um eine Ringform zu bilden, **dadurch gekennzeichnet, dass** die erste und die zweite Hälfte bearbeitet werden, um eine glatte Verbindungsstelle mit einer Toleranz von weniger als 0,1 Mikrometern zu erzeugen.

Revendications

1. Ensemble de bague collectrice (17) pour un ensemble d'hélice d'aéronef (10), comprenant :

une première et une seconde moitié d'une bague collectrice (31a, 31b, 31c ; 131a, 131b, 131c) ayant une surface de contact pour s'engager à rotation avec un élément de balai stationnaire (43A ; 143A) afin de transférer des signaux électriques entre eux, la surface de contact ayant une jonction (49 ; 149) de la première et de la seconde moitié ;
une attache (51, 53, 141) localisant la première et la seconde moitié pour obtenir une forme annulaire ; et
un contact électrique (39, 41) sur la bague pour acheminer des signaux électriques ;

caractérisé en ce que :

la première et la seconde moitié forment une jonction lisse avec une tolérance de moins de 0,1 micromètre lorsqu'elles sont assemblées sur un arbre rotatif (13).

2. Ensemble selon la revendication 1, dans lequel l'attache comprend un élément d'alignement (59) pour aligner la première et la seconde moitié afin de former la surface lisse à leur jonction.
3. Ensemble selon la revendication 2, dans lequel l'élément d'alignement (59) pour aligner la première et la seconde moitié afin de former la surface lisse à leur jonction est choisi parmi des goujons d'alignement et des cales d'alignement.
4. Ensemble selon la revendication 1, 2 ou 3, qui comprend en outre un élément de balai stationnaire (43A, 143A) en contact avec la surface rotative pour trans-

férer des signaux électriques entre eux, l'ensemble étant monté en relation opérationnelle avec un ensemble d'hélice d'aéronef (10).

- 5 5. Ensemble selon la revendication 1, 2, 3 ou 4, dans lequel l'attache comprend au moins deux paires de boulons et écrous (51, 53 ; 141) sur la ligne de séparation.
- 10 6. Ensemble selon l'une quelconque des revendications précédentes, dans lequel l'ensemble de bague collectrice comprend un élément de balai stationnaire (43A ; 143A) en contact avec la surface rotative et l'ensemble de bague collectrice est monté sur un ensemble à moyeu d'hélice (27) et à train d'engrenages (47) ayant un arbre d'entraînement (13) pour entraîner le moyeu.
- 15 7. Ensemble selon la revendication 6, dans lequel l'ensemble de bague collectrice est utilisé avec un conducteur chauffant (37) sur une hélice montée sur le moyeu d'hélice (27).
- 20 8. Ensemble selon la revendication 6 ou la revendication 7, dans lequel l'ensemble de bague collectrice est monté sur une bride arrière sur le moyeu d'hélice, qui raccorde le moyeu d'hélice à l'arbre d'entraînement (13) du train d'engrenages.
- 25 9. Ensemble selon la revendication 6, 7 ou 8, dans lequel le retrait de l'attache dans l'ensemble de bague collectrice et la séparation de la première et de la seconde moitié de la bague collectrice exposent les bagues collectrices à remplacer ou à réparer.
- 30 10. Ensemble selon l'une quelconque des revendications précédentes, dans lequel la ou chaque bague collectrice est plane.
- 35 11. Ensemble selon l'une quelconque des revendications précédentes, dans lequel la ou chaque bague collectrice est cylindrique.
- 40 12. Procédé de fabrication d'un ensemble de bague collectrice comprenant la formation d'une première et d'une seconde moitié d'une bague collectrice (31a, 31b, 31c ; 131a, 131b, 131c) entre elles ; l'assemblage conjoint de la première et de la seconde moitié et leur usinage pour produire une jonction ; l'assemblage des deux moitiés sur un arbre rotatif (13) ; et la jonction de la première et de la seconde moitié avec une attache (51, 53 ; 151) afin d'obtenir une forme annulaire ;
caractérisé en ce que la première et la seconde moitié sont usinées pour produire une jonction lisse avec une tolérance de moins de 0,1 micromètre.
- 45 50 55

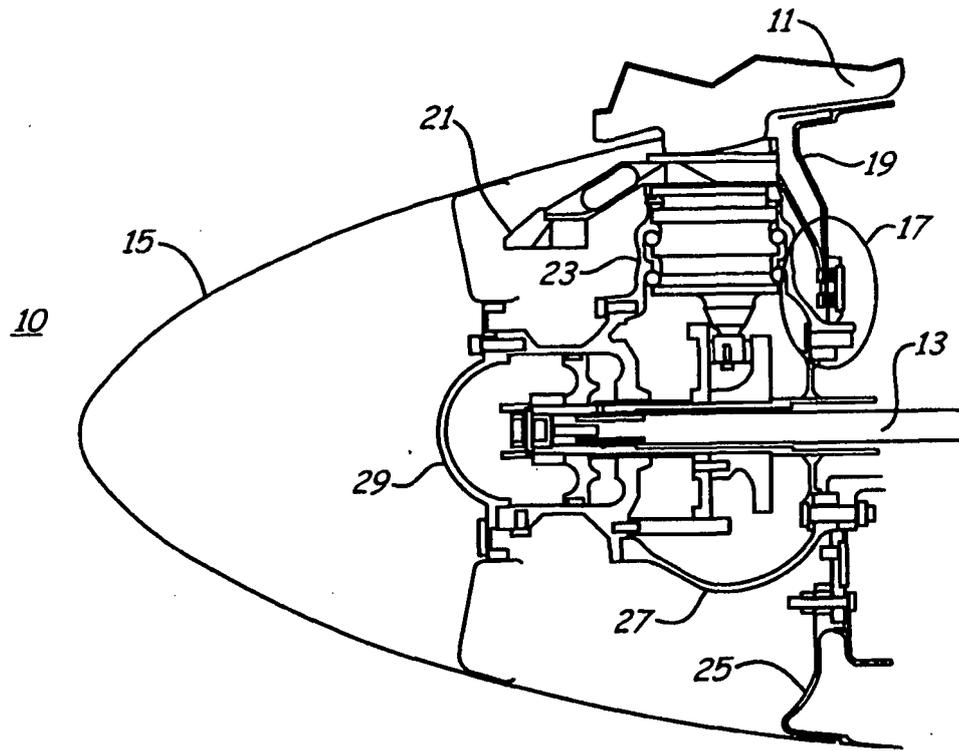


Fig. 1

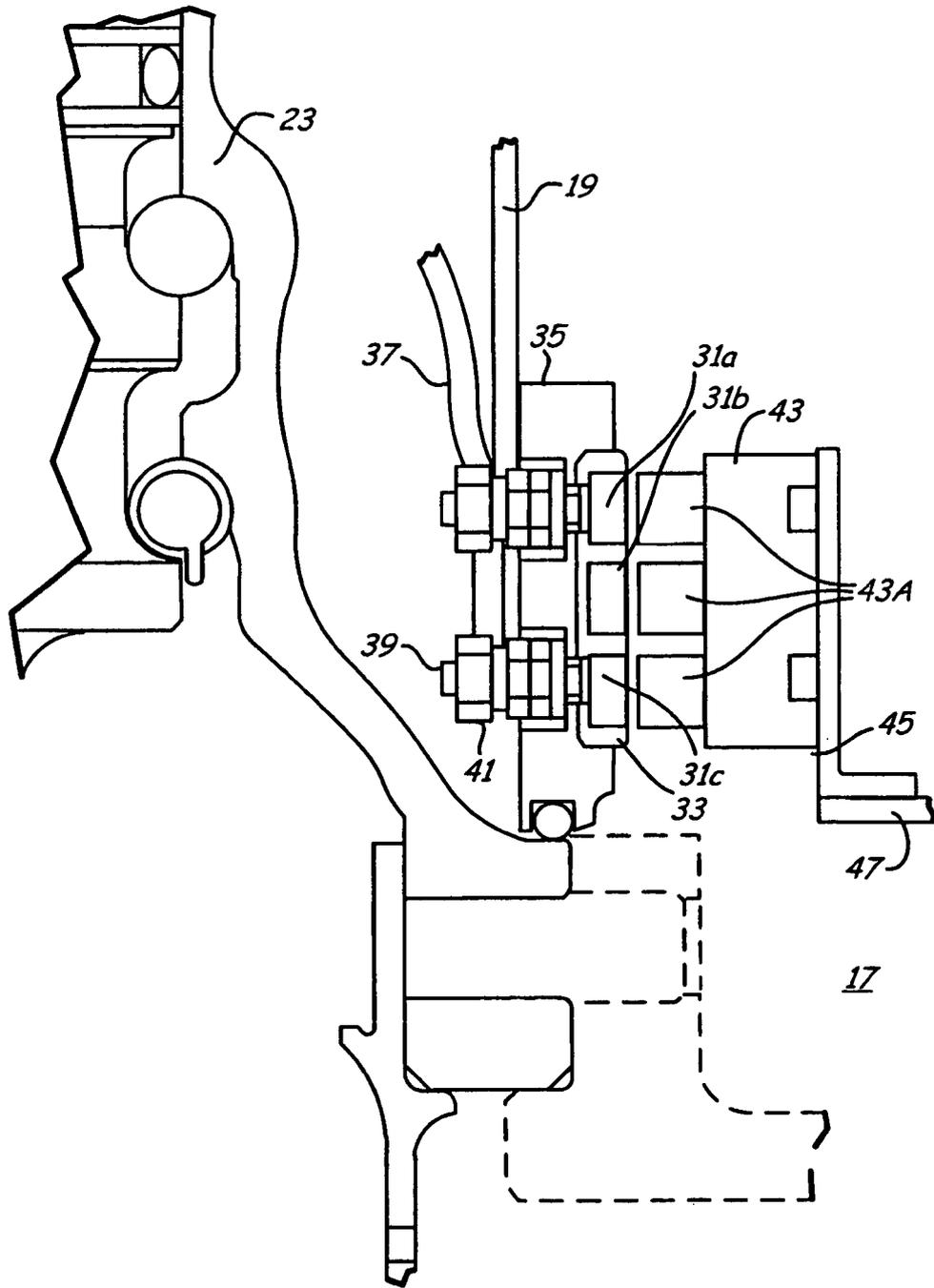


Fig. 2

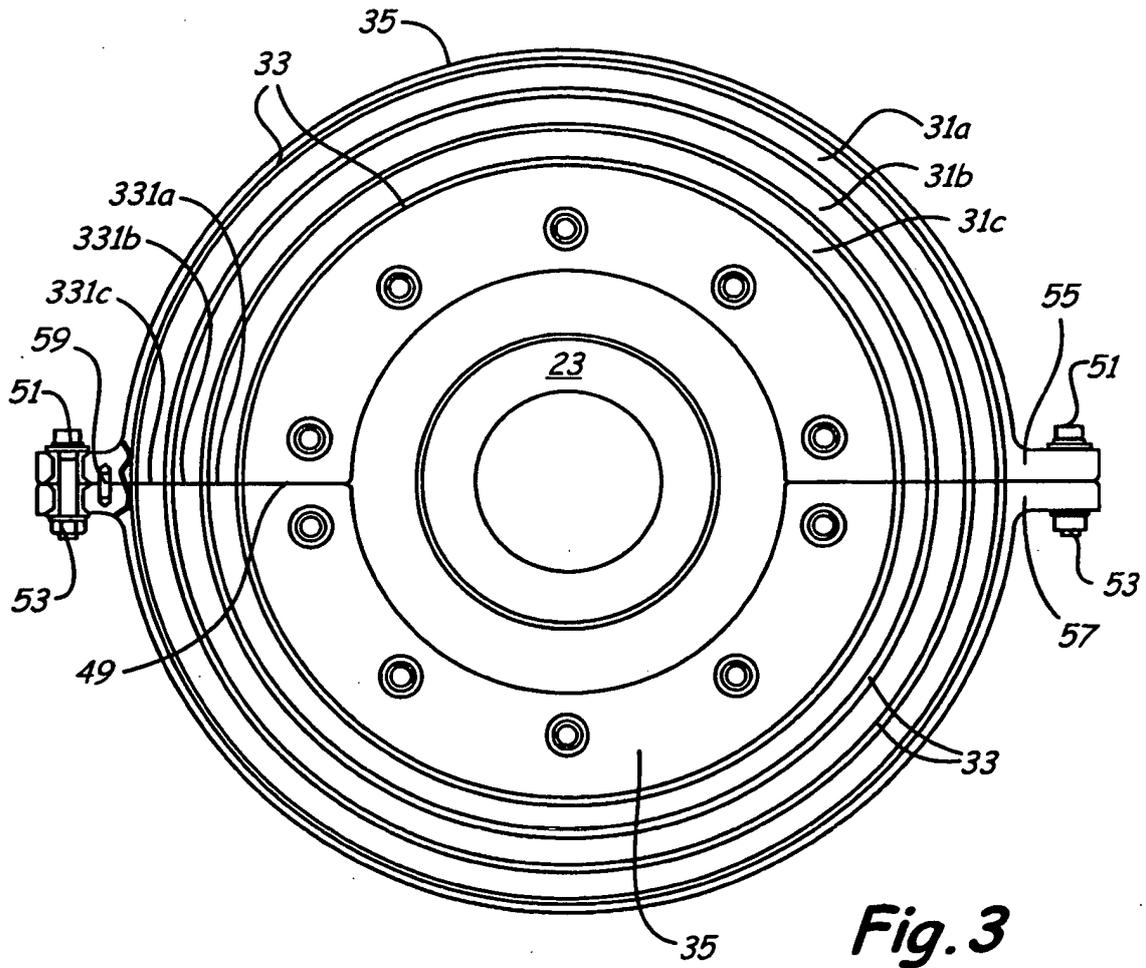


Fig. 3

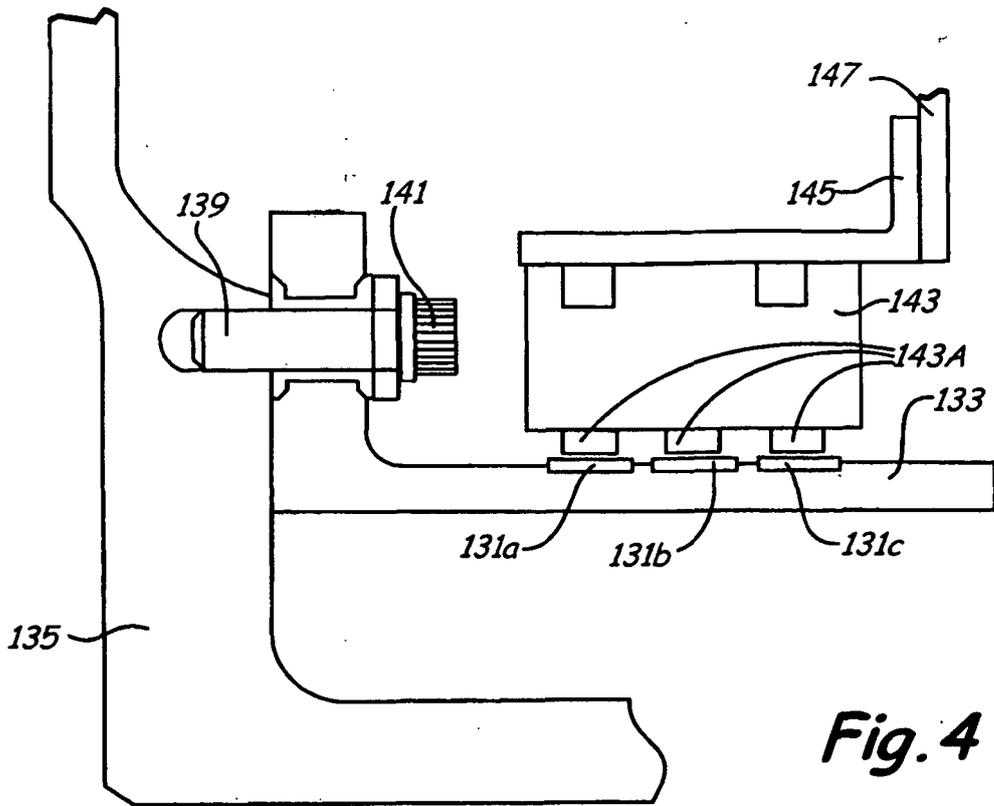


Fig. 4

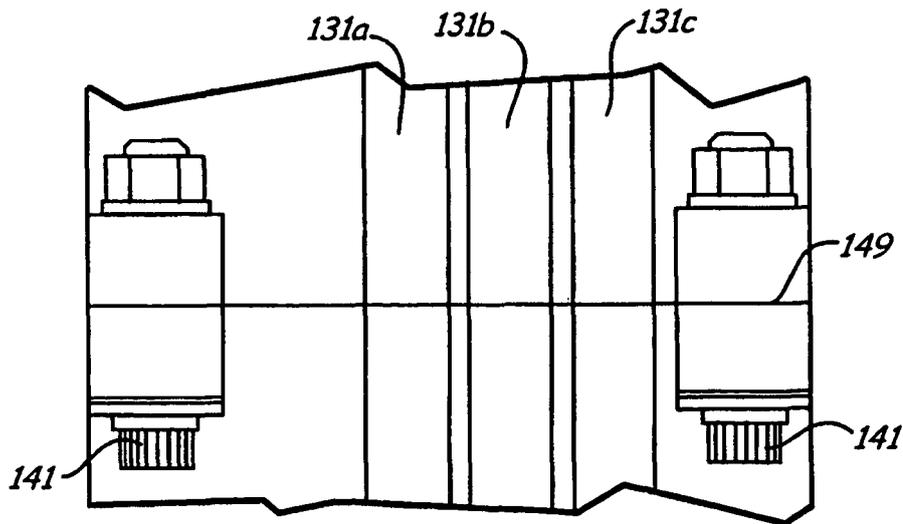


Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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